CLAIMS

What is claimed is:

1. An implantable medical device comprising:

a housing comprising a housing wall of biocompatible material defining an interior volume;

a battery comprising a case having a case wall, said battery mounted within said interior volume; and

heat absorbing means for reducing the amplitude of a temperature excursion of the implantable medical device to prevent significant damage to body tissue.

2. The device of claim 1 and further including dielectric spacers separating said case wall from said housing wall for reducing heat transfer to said housing.

3. The device of claim 1 wherein said heat absorbing means comprises:

paraffin; and

means for containing said paraffin.

4. The device of claim 3 wherein:

the containing means comprises an outer casing;

said battery is mounted within said outer casing; and

said paraffin is contained between the battery case wall and said outer casing.

5. The device of claim 4 wherein said outer casing is formed of a polymer.

6. The device of claim 3 wherein the containing means comprises a fibrous mat.

7. The device of claim 1 wherein said heat absorbing means comprises a heat absorber interposed between layers of electrodes and separators.

8. The device of claim 7 wherein the electrodes and separators are configured to form an electrode assembly roll.

9. The device of claim 7 wherein the electrodes and separators are configured to form an electrode assembly stack.

10. The device of claim 1 wherein said heat absorbing means comprises a heat absorber extending around electrodes and separators within the battery case.

11. The device of claim 1 and wherein said heat absorbing means comprises:
a heat absorber;
a caddy configured to carry said heat absorber; and
clips for attaching said caddy to the battery case.

12. The device of claim 1 wherein said electrodes comprise active material coated on a substrate, and wherein said heat absorbing means comprises a heat absorber deposited into recesses or pockets of said substrate.

13. The device of claim 1 and wherein said battery comprises an electrode assembly having positive and negative electrodes separated by a separator, wherein said separator has pockets into which a heat absorber is deposited to form said heat absorbing means.

14. The device of claim 1 wherein said housing comprises a material chosen from the group consisting of titanium and stainless steel, and wherein the battery case comprises a material chosen from the group consisting of titanium, stainless steel, and a flexible polymer.

15. A device comprising:
a housing comprising a wall defining an interior housing volume;
a battery comprising a case having a wall enclosing an interior case volume, said battery capable of producing a temperature greater than a temperature T1;
said battery mounted in said housing with said case wall spaced from said housing wall; and
a heat absorber mounted adjacent to and closely thermally coupled to said case wall, said heat absorber comprising a high heat capacity material exhibiting a phase change at said temperature T1.

16. The device of claim 15 wherein said heat absorber further comprises a fibrous containment mat embedded in said high heat capacity material.

17. The device of claim 16 wherein said fibrous containment mat is formed of dielectric fibers.

18. The device of claim 16 wherein said fibrous containment mat comprises Kevlar.

19. The device of claim 16 wherein said fibrous containment mat comprises fiberglass.

20. The device of claim 15 wherein said high heat capacity material includes paraffin.

21. The device of claim 15 wherein said energy storage device includes a case having a wall outer surface, and wherein said high heat capacity material contacts said case wall outer surface.

22. The device of claim 15 wherein said temperature T1 is within the range of 50°C to 80°C.

23. In a storage device comprising a case enclosing an interior volume and including an electrode assembly comprising materials forming positive and negative electrode layers separated by a separator in said interior volume, the improvement comprising:

a heat absorbing layer interposed between the electrode and separator layers, said heat absorbing layer having a high heat capacity relative to the other materials in said interior volume, said heat absorbing layer comprising at least one material that exhibits a phase change at a temperature lower than that of the electrode and separator layers.

24. The storage device of claim 23 wherein the at least one material that exhibits a phase change comprises paraffin.

25. A lithium ion battery including:

a case comprising a wall enclosing an interior volume;

an electrode assembly in said interior volume including materials comprising an electrolyte, a positive electrode, a negative electrode, and a separator separating said positive and negative electrodes; and

a heat absorber for limiting temperature increases in the battery, wherein said heat absorber is:

characterized by a heat capacity at least as great as the materials of said electrode assembly;

mounted in said interior volume; and

inert with respect to the materials of said electrode assembly.

26. The battery of claim 25 wherein said heat absorber is mounted in said interior volume between said electrode assembly and an interior surface of said wall.

27. The battery of claim 25 wherein said heat absorber is incorporated in said electrode assembly.

28. The battery of claim 25 wherein said heat absorber comprises a material that exhibits a phase change at a temperature lower than that of the materials of the electrodes and separator.

29. The battery of claim 25 wherein said heat absorber comprises a mat of dielectric material embedded in paraffin.

30. The battery of claim 29 wherein said dielectric material is fiberglass.

31. The battery of claim 29 wherein said dielectric material is Kevlar.

32. An apparatus comprising:

an energy storage device capable of producing a temperature greater than a temperature T1; and

a heat absorber closely thermally coupled to said storage device, said heat absorber comprising:

a quantity of high heat capacity material exhibiting a phase change at said temperature T1; and

a fibrous containment mat embedded in the high heat capacity material.

33. The apparatus of claim 32 wherein said fibrous containment mat is formed of dielectric fibers.

34. The apparatus of claim 32 wherein said fibrous containment mat comprises Kevlar.

35. The apparatus of claim 32 wherein said fibrous containment mat comprises fiberglass.

36. The apparatus of claim 32 wherein said high heat capacity material includes paraffin.

37. The apparatus of claim 32 wherein said energy storage device includes a case having a wall outer surface, and wherein said high heat capacity material contacts said wall outer surface.

38. The apparatus of claim 32 wherein said temperature T1 is within the range of 50°C to 80°C.

39. A method of limiting temperature excursions of a battery having an electrode assembly within a battery case, said method comprising:

providing a mat of fibrous material;

depositing a quantity of a melted high heat capacity material into said mat;

allowing said high heat capacity material to solidify to form a mass including said fibrous material embedded therein; and

thermally coupling said mass to said battery case.

40. The method of claim 39 wherein said providing step comprises providing a mat of dielectric material.

41. The method of claim 39 wherein said providing step comprises providing a mat of fiberglass.

42. The method of claim 39 wherein said providing step comprises providing a mat of Kevlar.

43. The method of claim 39 wherein said depositing step comprises depositing a quantity of melted high heat capacity material having a melt point within a range of about 50°C to 80°C.

44. The method of claim 39 wherein said depositing step comprises depositing paraffin.

45. The method of claim 39 wherein said depositing step comprises depositing polyethylene.

46. The method of claim 39 wherein said depositing step comprises depositing polypropylene.

47. The method of claim 39 wherein said thermally coupling step comprises mounting said mass to an outer wall of said battery case.

48. The method of claim 39 wherein said thermally coupling step comprises integrating said mass into said electrode assembly.

49. The method of claim 39 wherein said thermally coupling step comprises including said mass within said battery case, wherein said mass extends around said electrode assembly.